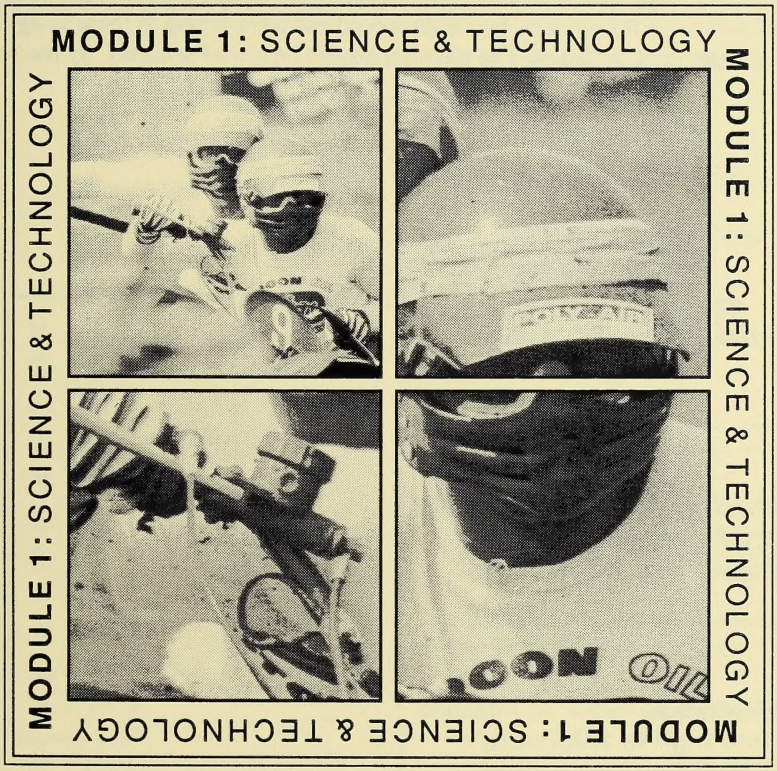
SCIENCE 14



Learning Facilitator's Manual

Distance Learning

Alberta EDUCATION

Note

This Science Learning Facilitator's Manual contains answers to teacher-assessed assignments; therefore, it should be kept secure by the teacher. Students should not have access to these assignments until they are assigned in a supervised situation. The answers should be stored securely by the teacher at all times.

Science 14
Learning Facilitator's Manual
Module 1
Science and Technology
Alberta Distance Learning Centre
ISBN No. 0-7741-0299-3

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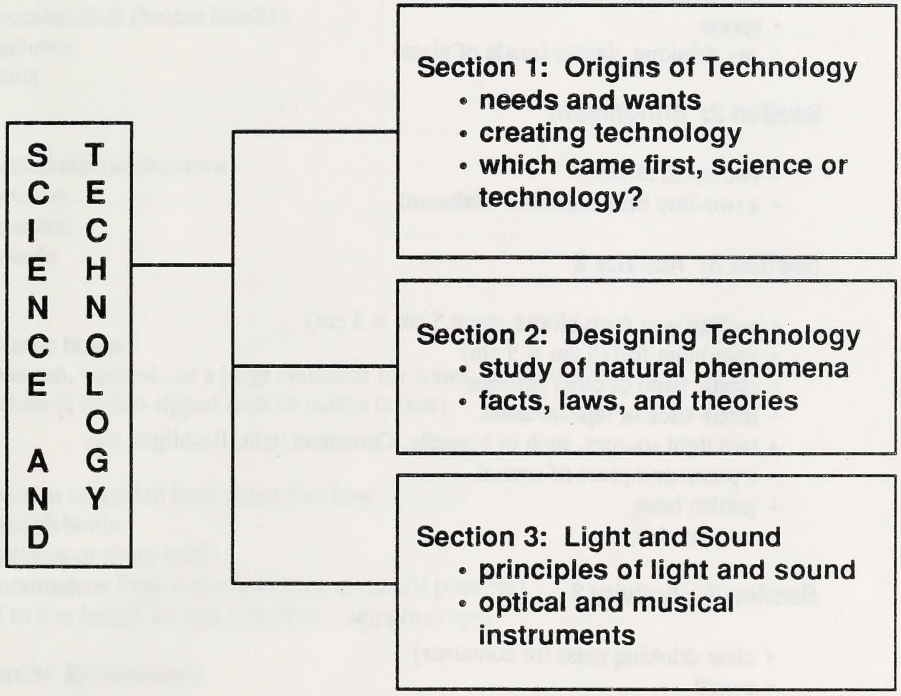
Module 1 – Science and Technology: Overview

The emphasis in this module is on having students actually **do** things, **make** things, and **test** things. A student should make and test several of the devices shown before completing this module.

The only equipment available in the lab kit is a hand lens and a microscope slide. Any kitchen should have the rest of the materials needed to do the activities. The purpose is to see technology as it already exists in the student's home and neighbourhood.



Materials You Need

The following is a list of materials necessary to complete the investigations in Module 1.

Section 2: Activity 2

- flashlight
- heavy paper or cardboard
- clear drinking glass or other container
- mirror
- cornstarch
- water
- scissors or a sharp knife
- pop bottle (any size)
- spoon
- any drinking glasses (made of glass)

Section 2: Enrichment

- two small mirrors
- a two-litre milk carton or cardboard

Section 3: Activity 2

- sealing wax (two blocks about 5 cm × 5 cm)
- aluminum foil (5 cm × 5 cm)
- elastic band or other fastener
- metre stick or tape measure
- two light sources, such as a candle, Christmas light, flashlight, etc.
- a prism or a piece of crystal
- garden hose
- a sunny day

Section 3: Activity 3

- clear drinking glass (or container)
- pencil
- water
- hand lens or magnifying glass
- microscope slide
- newspaper
- spoon

Section 3: Activity 4

- hand lens
- printed material (newspaper, magazine, etc.)
- ruler or measuring tape
- shaving mirror (make-up mirror)
- water
- microscope slide

Section 3: Activity 6

I.

- old wash tub
- string
- wooden stick (broom handle)
- hammer
- nails

II.

- milkshake (thick) straw
- scissors
- matches
- needle

III.

- plastic bowls
- bathtub, washtub, or a large container for water, (pails are fine)
- sticks (a rubber-tipped stick or mallet is best)

IV.

- section of garden hose about 2 m long
- bleach bottle
- scissors or sharp knife
- mouthpiece from a real brass instrument (if possible)
- 3 to 5 m length of rope (could be a skipping rope)

Section 3: Enrichment

- 8 or 16 test tubes (or any tubes you can find)
- water

Bibliography

Macaulay, David. The Way Things Work. Boston: Houghton Mifflin Company, 1988.

Possible Media

Video series *Connections*
Video series *The Acme School of Stuff*
Video series *MacGyver*

Note: Some of the suggested media may not be authorized by Alberta Education. Teachers should use their own discretion regarding the use of these resources in their classroom.

Evaluation

Your mark in this module will be determined by your work in the Assignment Booklet. You must complete all assignments. In this module you are expected to complete three section assignments. The assignment breakdown is as follows:

Section 1	=	25 marks
Section 2	=	35 marks
Section 3	=	40 marks
TOTAL	=	100 marks

Section 1: Origins of Technology

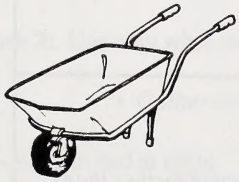
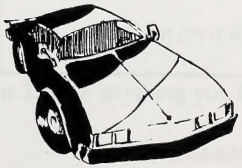
This section looks at why we have made the technology we have and how technology advances. A field trip to any museum would be useful for this section.

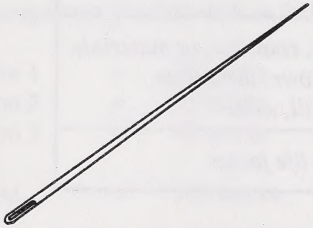
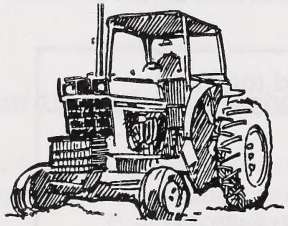
Section 1: Activity 1

1. Name a device or a technology that is satisfying the needs or wants described in the chart.

Need (Want)	Technology or Device
cook food outdoors	*fire, barbecue, camp stove*
cook food indoors	*hotplate, stove*
lift a car to change a tire	*jack, jackscrew*
see very small things	*microscope, magnifying glass*
push a fridge up into a truck	*ramp, inclined plane*
have sure-footing when playing games	*running shoes, cleats*
stay warm outside at – 40°C	*boots, coat, hat, or materials like down, thinsulate, fiberfill, wool*
stay up when in water	*boat, life jacket*

2. Complete the chart by describing a need or want that these devices are satisfying.

Device	Need (or Want)
	• *to lift heavy loads and carry them*
	• *to transport people from place to place quickly*

Device	Need (or Want)
	• *to see things that are far away*
	• *to provide a steady source of electricity*
	• *to push a thread through material*
	• *to allow farmers to work very large farms*
	• *to project a voice farther than normal*

Device	Need (or Want)
	• *to carry things into orbit around the Earth*

Section 1: Activity 2

Describe how you would go about performing a simple task under the following conditions. You must choose one of the tasks.

Here are some possible answers. If you have other similar ones, that's fine.

Task 1 – Lift a heavy boulder 2 m.

Condition 1: You have today's technology to use.

- *Use a bulldozer or a tractor with a front-end loader.*
- *Use a crane.*
- *Tie a pulley over the boulder and pull it with a vehicle.*

Condition 2: Use anything you like, except electricity.

- *Cars and other vehicles use electricity so they won't count for this exercise.*
- *Use a strong ramp or make one out of sand.*
- *Use a pulley system.*
- *Use a lever.*

Condition 3: Use only what your body can do.

- *Gather several friends and lift the boulder.*

Task 2 – Read in bed at night.

Condition 1: You have today's technology to use.

- *Turn on a light or flashlight.*

Condition 2: Use anything you like, except electricity.

- *Use a candle.*
- *Use a kerosene lamp.*

Condition 3: Use only what your body can do.

- *Hope that the moon is out.*

Task 3 – Listen to some music performed by your favourite band.

Condition 1: You have today's technology to use.

- *Play a tape, record, video, or compact disc.*

Condition 2: Use anything you like, except electricity.

Condition 3: Use only what your body can do.

- *Go somewhere to hear them live.*

Section 1: Activity 3

1. Try to think of three needs that you or other people have for which the technology has not been developed yet. It's not easy to do. An example might be a solar-powered passenger plane.

   List them here.

   Most answers are acceptable. This is a difficult question to do.

   - *things to fix the ozone hole*
   - *three-dimensional TV*
   - *flying cars*

   There are many possibilities for this question.

2. Suppose you were asked to invent or design a device to satisfy one of these needs. What problems would you run into?

   Here are some of the many problems.

   - *What materials should you use?*
   - *"Where do I start?" (You can't get a good idea.)*
   - *You have an idea that uses gears (or something else), but you don't know how they work.*
   - *You have too many ideas! Which one will you use?*

   This question is open-ended. This means that you may have several other ideas as well.

   Teacher Comment: A discussion session would help here if possible.

Section 1: Activity 4

Write S → T if the following example shows how science advances technology. Write T → S if it's an example of technology advancing science.

1. The Voyageur II spacecraft sent back pictures of Neptune. *T → S*
2. A robot submarine showed pictures from the deepest ocean trenches. *T → S*
3. Research on spiders' webs led to a way of making synthetic fibres. *S → T*
4. Chemical research provided the basis for the development of photography. *S → T*

Section 1: Follow-up Activities

Extra Help

1. Choose words from Column B to complete the statements in Column A.

   a. Humans need to eat. Technologies developed to satisfy this need are *plows*, *tractors*, and *refrigerators*.

   b. Modern society needs to communicate at a distance. Some technologies developed to satisfy this need are *radios*, *televisions*, and *satellites*.

   c. People want to look good for their friends. Technologies developed to satisfy this want are *toothpaste*, *combs*, and *mirrors*.

2. Put the following technologies in order from the earliest to the most modern technology: space shuttle, fire, electricity, and roads.

   Early ——————————————→ Modern

   fire → *roads* → *electricity* → *space shuttle*

Enrichment

1. Write a description of how you would cook a meal consisting of meat, potatoes, and corn, if you couldn't use electricity or natural gas.

   Here are some ideas to consider:

   - *Do the foods need to be cooked?*
   - *What sources of heat are available?*
   - *Can you do it inside a home?*
   - *Do you know of any high-tech ideas that you could use?*

or

2. Draw a diagram of a kitchen that might have been found in early Alberta (before 1900).

   Here are some ideas to consider:

   - *There is no electricity or central heating.*
   - *Does your kitchen have a fireplace?*
   - *Where is water stored? heated?*
   - *What utensils would a cook use?*
   - *What is used to keep things cold?*

Section 2: Designing Technology

This section reviews the process of designing technology as follows:

observe nature ⟹ scientific inquiry ⇓

apply them ⟸ discover principles

A field trip to a planetarium would be appropriate for this section.

Section 2: Activity 1

1. As an aid in helping you remember the new terms, write their definitions in the following spaces.

   a. phenomenon: *an event, anything that occurs*

   b. law: *a rule, pattern, or principle that has been established by observing events*

   c. theory: *an explanation of why events occur as they do*

2. Write *theory* or *law* beside these statements.

   a. Light travels in straight lines. _____*law*_____

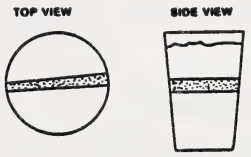
   b. Lights travels faster than sound; that is why the thunder is heard after the lightning is seen. _____*theory*_____

   c. A high C musical note has a shorter wavelength than a low C note. _____*theory*_____

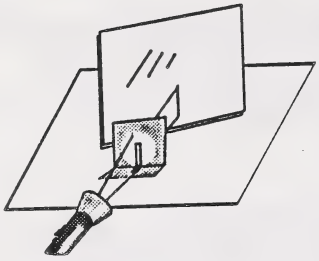
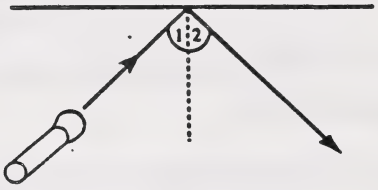
Section 2: Activity 2

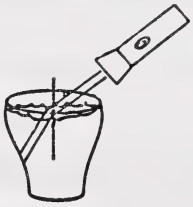
Investigation A: Light

STEP E	OBSERVATION
Set the beam up on a table and sprinkle some dust **above** the beam. Diagram what you see.	Draw the beam after it gets through the slit.  *It's straight. The beam might spread a bit. Check your alignment if you can't see it.*

STEP G	OBSERVATION
Turn the lights off and shine the beam through the glass. Observe it from above and from the side. Diagram what you see.	Draw the beam in the water from 

Teacher Comment: Patience is needed to do this properly. The beam isn't very good, but a careful observer should be able to see it.

STEP H	OBSERVATION
Set the beam on the table again and stand a mirror up in the beam's path. Diagram what you see. 	Draw the beam as it hits and leaves the mirror. *Angles 1 and 2 are equal.* 

STEP I	OBSERVATION
Shine the beam down onto the water's surface as shown. Diagram what you see. 	Draw the beam as it enters the glass from above. *The beam is straight. However, if you look carefully, you will see that it angles a bit from its original direction.* 

Investigation B: Sound

1. As more water was put in the bottle, the pitch went *up* .

2. As more water was put in the bottle, the size of the airspace *got smaller* .

STEP D	OBSERVATION
Take the spoon and gently tap several different sizes of glasses. Draw a diagram of them and write high pitch, medium pitch, or low pitch beside the diagrams. 	Draw several glasses and describe the pitch made by tapping them. *There is probably no relationship between glass size and pitch. Big glasses are sometimes higher and sometimes lower than small ones.*

3. As more water is put in the cup, the pitch *goes down* .

4. The biggest difference in pitch happens when the water is *very near the top* .

Section 2: Activity 3

1. A principle based on observation is a *law* .

2. An event that is 100 percent sure is a *fact* .

3. An explanation of a principle is a *theory* .

4. Before you can build a device based on some natural phenomenon, you should *test or experiment to learn some law or principle that's working.*

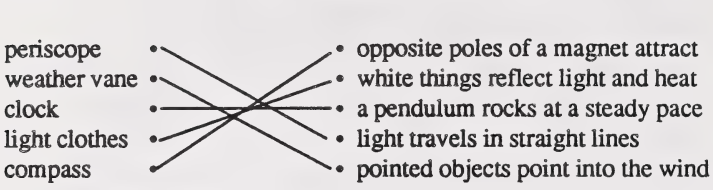
5. Make a telescope. *third*
   Light bends when it goes through a lens. *first*
   A lens can focus an image. *second*

6. Larger objects make lower sounds. *second*
   Vibrating objects can make sound. *first*
   Make a tuning fork for a certain note. *third*

Section 2: Follow-up Activities

Extra Help

1. Here are some devices and some laws. Draw a line connecting the law to the device it's based on. (One has been done as an example.)



2. When investigating something, what is your conclusion based on?

   Your conclusion will depend on your observations.

3. Use the following terms to finish this paragraph. Each term may be used more than once.
   facts, test, theories, laws, phenomenon

   Technology is developed after some _____*laws*_____ are known about a natural _____*phenomenon*_____. _____*Facts*_____ are 100 percent certain events. In science, facts are confused with _____*laws*_____ and _____*theories*_____. Laws are believed more and more everytime they survive another _____*test*_____.

Enrichment

Build a periscope – one of the devices mentioned in this section. Here are some hints to guide you.

What you need to do is to put two mirrors into a box or tube so that they are at a 45° angle to the box and they face each other. A one- or two-litre milk container makes a good box for this.

Make sure that the mirrors are set at 45° angles, that the mirrors face each other, and that they line up well.

Teacher Comment: Finding the right sized mirrors is the hardest part of this. If a box is cut up, any size tube can be made. The tube can be made to match any mirrors.

Section 3: Light and Sound

This section looks at a few principles operating with light and sound and how they are applied to make things. All four concepts for this unit of the curriculum are covered in an integrated way. A field trip to a music repair shop or a sound centre sales outlet would be appropriate. A number of guest speakers such as a musician, instrument maker, amateur photographer, or amateur astronomer could help enrich this section.

Section 3: Activity 1

1. Compare a bright white light to a dim white light.

   The bright light has more photons than the dim one.

2. Compare two equally bright lights, one blue and one red.

   They have the same number of photons, but the blue light photons have shorter wavelengths than the red light photons.

3. Compare a dim red light to a bright green light.

   The dim red light has fewer photons with longer wavelengths, while the bright green light has many photons with shorter wavelengths.

4. According to the diagram of "The Visible Spectrum," what is the relationship between the energy and the frequency of a photon?

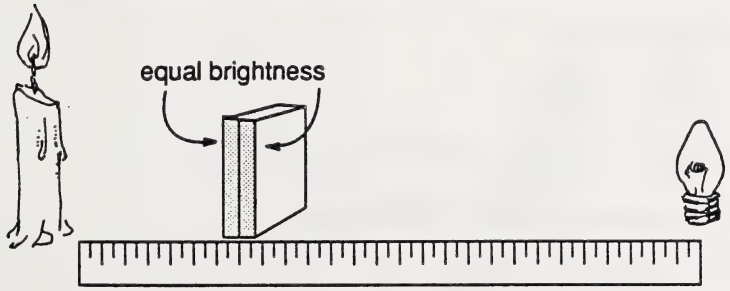
   As the frequency increases, the energy increases (goes up).

Section 3: Activity 2

Investigation A: Comparing the Intensities of Light Sources

1. How can you decide which light is brighter?

   The brighter light is the farthest from the spot you marked. For example



   The Christmas light is brighter than the candle.

Teacher Comment: This device works really well. The wax should be of equal thickness.

2. Why did you turn the photometer over and repeat step C and step D?

   The photometer was turned over to doublecheck your measurements and the accuracy of the photometer.

3. What could you say about your photometer if you marked the *same* spot in step D that you marked in step C?

   The photometer works well. It also means that the two wax pieces have the same thickness.

Investigation B: Rainbow Colours

4. Do you see all the colours that are on the spectrum chart in Activity 1?

5. List the colours you do see.

6. Which colour is brightest?

7. Which colour is the widest?

8. The sun is yellow to your eyes. Do you see anything surprising about the spectrum?

Following are the answers if you used a prism.

4. Yes, all the colours can be seen.

5. Red, orange, yellow, green, blue, and violet (maybe) are the colours seen.

6. Green and yellow are the brightest colours.

7. Green is the widest band.

8. Yellow is a very narrow band.

Teacher Comment: A prism **only** works in direct sunlight for this activity.

Following are the answers if you used a water spray.

4. No, all the colours can't be seen.

5. Orange (maybe), yellow, green, blue, and violet (maybe) are the colours seen.

6. Yellow and green are the brightest colours.

7. Blue is the widest band.

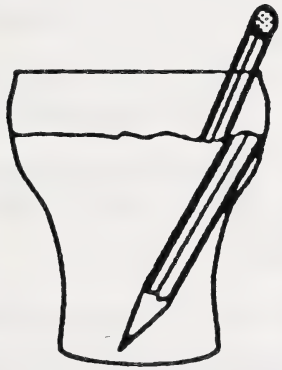
8. Yellow is a faint and a narrow band.

Section 3: Activity 3

1. Put a pencil into a glass full of water and draw its appearance.

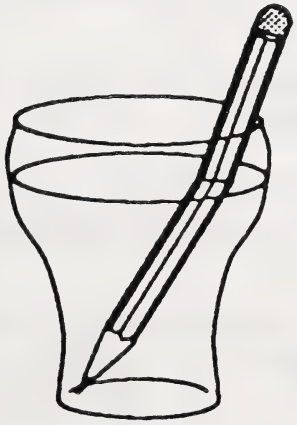
   a. from the side

   The part of the pencil in the water appears to be thicker and at a different angle than the part of the pencil in the air.



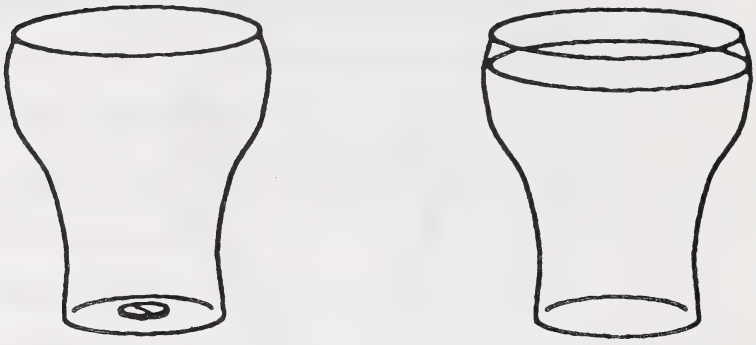
   b. from an angle

   The pencil appears to be at the same angle and the same thickness until it is seen in the water; then it bends to a different angle.



2. Place a penny under an empty glass. Observe it at an angle and draw what you see. Then add water until the glass is full and draw what you see.

Empty *Full*



penny shows clearly *penny disappears*

Teacher Comment: The glass must be viewed at the proper angle to see this work.

Investigation A: Lenses

3. Take a hand lens (magnifying glass), or put a small drop of water on a piece of glass. Put the lens or drop close to some small type (a newspaper) and describe how the print appears.

   The print is bigger and right-side-up. It may be distorted if you are using a water drop.

4. Move the lens farther away from the print until it is at least 30 cm away. Describe how the image of the print changes as you do this.

   As you move the lens away the print gets bigger, then disappears, and then appears again upside-down.

5. Darken the room except for one window. Place the lens near the wall opposite the window, and move it closer and then farther until you see an image of the window on the wall. Describe this image. (This can't be done with the drop of water. However, the drop can make an image of a ceiling light on a table.)

   The image is a clear picture of the window (or light). The image is upside-down and smaller than the actual window (or light).

Investigation B: Mirrors

6. Take a shiny spoon and find your reflection in its back side. Describe the reflection.

   The image is smaller than life and right-side-up. It's distorted a bit, too.

7. Holding the spoon at least 30 cm away from you, find your reflection on the front side of the spoon. Describe your reflection.

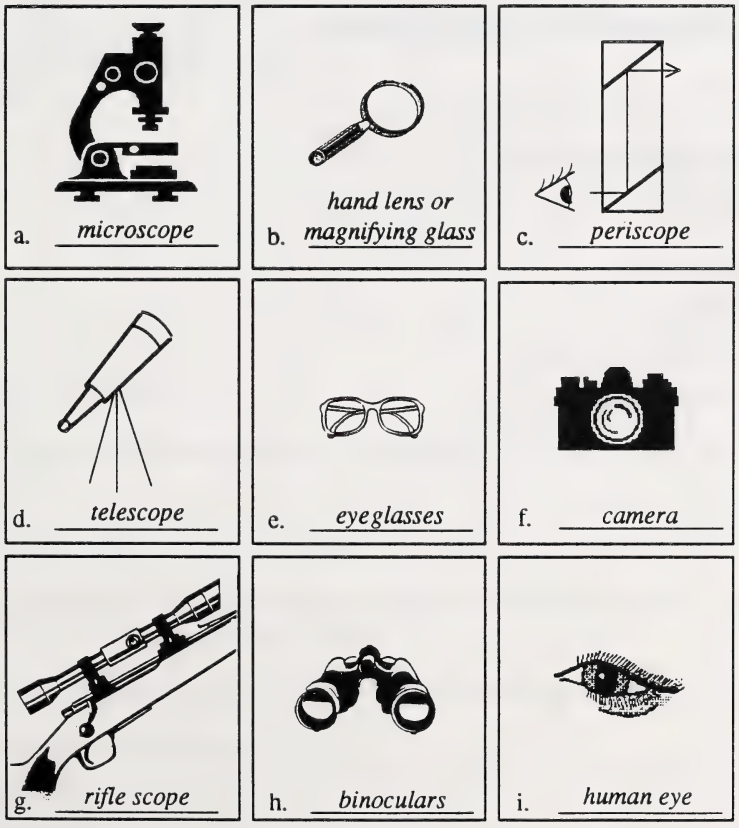
   The image is small and upside-down.

8. With the front side of the spoon still toward you, move the spoon as close to your eye as you can and describe how the image changes as you do this.

   As you move closer the image gets larger, disappears, and appears again right-side-up and very large. (You have to get the spoon very close to your eye to see the right-side-up image.)

Section 3: Activity 4

1. Label as many of these instruments as you can.



Investigation A: Lenses, Mirrors, and Telescopes

Part I – Finding the Focal Length of a Lens

STEP C

Measure the distance from the lens to the print. This is the focal length (f).

focal length (f) = 7.5 cm (large lens)

focal length (f) = 3.75 cm (small lens)

Teacher Comment: If you have access to different lenses, substitute one for the drop.

Part II – Finding the Focal Length of a Mirror

STEP C

Measure the distance from the lens to the print. This is the focal length (f).

Your focal length will be different for each mirror. It's probably about 50 cm, but answers can be far from that as well. The bigger your face in the mirror, the shorter the focal length.

Part III – The Homemade Telescope

STEP B	OBSERVATION
Adjust the two lenses until you see a clear image of the type in the drop in the hand lens.	2. Describe the image. *The image appears larger and upside-down when using the telescope.*

STEP C	OBSERVATION
Reverse the hand lens and the drop. Focus the image by moving one lens, or both, closer to the print. Move them farther away.	3. What combination gives you the best image? *Use a small drop of water; the best image occurs when the drop is close to the print. The fact that the drop isn't very regular in shape limits you to doing it this way.*

Section 3: Activity 5

1. If sound is a compression wave of air molecules, can sound travel in outer space? Why or why not?

   No, there are no molecules to compress.

2. If you have ever been underwater at a lake when a motorboat went by, you know sound can travel in water, too. What is sound in water?

   Sound in water is a compression wave of water molecules.

3. Can sound travel in a solid?

   Yes, sound can travel in a solid.

4. Can sound travel through walls?

   Yes, sound can travel through walls.

5. Suppose you yell and hear your echo 8 seconds later. How wide is that valley?

   The valley is 1.36 km wide.

6. If a boat sent a sonar pulse out in water 10 km deep, how long would it take for the pulse to come back?

   It would take 20 seconds for the sonar pulse to return.

Section 3: Activity 6

1. Place the instruments listed at the right into the class that they belong to. You may have to look some of them up.

Strings	*guitar* *banjo* *harp* *piano (The piano can also be a percussion instrument.)*
Woodwinds	*clarinet* *oboe* *saxophone*
Brass	*trumpet* *trombone* *tuba*

Percussion	*drum* *xylophone* *cymbal*

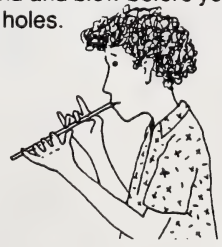
Teacher Comment: Most students are surprised that the saxophone is a woodwind instrument. It is made of brass; however, it uses a reed thus making it a woodwind.

Investigation: Homemade Music

Part I

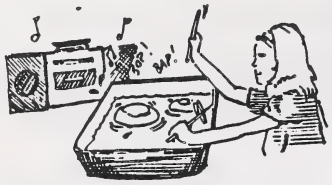
STEP F	OBSERVATION
Play a tune. 	2. Describe the sounds your washtub bass makes. *A washtub bass makes a low-pitched thumping note amplified by the washtub. A tune is possible.*

Part II

STEP F	OBSERVATIONS
Play a tune. Note: If you have another straw, cut the end and blow before you melt any holes. 	3. Describe the sound your straw oboe makes. *A straw oboe makes a loud buzzing note. A tune is possible if the holes are placed correctly. (This is very hard to do.)*

Teacher Comment: Match holes to those of a recorder, if you can get a recorder.

Part III

STEP E	OBSERVATIONS
Play with some other music. 	4. Describe the sound your water drums make. *A water drum makes a deep resonating thump. The pitch is lower when there is very little water in the bowl. A rubber mallet works best.*

Part IV

STEP E	OBSERVATIONS
Change how tightly you are pressing your lips together to get different sounds. Unless you really play a brass instrument you won't get much of a tune.	5. Describe the sound your trumpet makes. *A hose trombone makes a sick animal call – a very ugly sound by most people's standards. A trumpet player could make it sound nice though.*

6. What can you say about the pitch of a note and the length of the standing wave that makes it?

   The pitch is higher when the wavelength is shorter.

7. Frequency increases when the wavelength gets shorter. What can you say about frequency and pitch?

   When the frequency is high, the pitch is also high.

Section 3: Follow-up Activities

Extra Help

1. Complete this chart comparing sound with light. Remember, they are very different things.

	Light	Sound
Frequency (determined by wavelength)	*colour*	*pitch*
Speed	*300 000 km/s*	*330 m/s (air)*
Theory – what they are	*stream of photons*	*vibrating air molecules*

2. Name two optical instruments that use lenses.

   Optical instruments that use lenses are eyeglasses, telescopes, microscopes, rifle scopes, magnifying glasses, cameras, binoculars, and eyes.

3. Name two optical instruments that use mirrors.

   Optical instruments that use mirrors are periscopes, shaving mirrors (make-up mirrors), reflecting telescopes, and reflectors for headlights.

4. Name two instruments for each of these four classes:

   Strings

   - *guitar*
   - *banjo*
   - *piano*
   - *harp*
   - *mandolin*

   Woodwind

   - *clarinet*
   - *oboe*
   - *flute*
   - *saxophone*

Brass

- *trumpet*
- *trombone*
- *tuba*
- *French horn*

Percussion

- *drum*
- *xylophone*
- *bell*
- *triangle*

Module Summary

A *science olympics* is one very good way to culminate the module. Contests could include students who can make

- a band consisting of homemade instruments (in tune)
- a solar collector (most temperature gain in a beaker of water in five minutes)
- a model of a 100-year-old household

Key to the Assignment Booklet

Section 1 Assignment (25 marks)

(9 marks) 1. It is a sad fact that most technology was developed for war. When the wartime need is less present, a peacetime use for the technology is found. Choose **three** of the following technologies and give a wartime and peacetime use for them.

- rockets
- lasers
- guns
- boats (ships)
- roads
- coffee beans

Rockets – *are used as bombs in wartime*
– *are used for research, fireworks, and toys in peacetime*

Lasers – *are used as gun sights and blinding weapons in wartime*
– *are used for research, surveying, and telephone communication in peacetime*

Guns – *are used to kill people in wartime*
– *are used to hunt and sportshoot in peacetime*
They also kill people in peacetime (criminals, police, etc.).

Boats – *are used as battleships in wartime*
– *are used for sports, leisure, fishing, and research in peacetime*

Roads – *are used as transportation routes to move troops and supplies in wartime*
– *are used as transportation routes to move people and goods in peacetime*

Coffee beans – *are used to prevent battle fatigue*
Ethiopian warriors chewed the beans in wartime.
– *are used to provide us with a drink in peacetime*

(6 marks) 2. If you lived in Alberta 100 years ago, many things that you now take for granted wouldn't have been available to you. Pretend it's AD 1900. Compare **two** of the following tasks as to how each would be accomplished then and now.

- travelling 200 km
- listening to music
- taking a bath
- sewing a shirt

Travelling 200 km – *This would be a trip that would take several days 100 years ago. In Alberta you would travel by foot, horseback, or canoe. Today it is a 2 hour drive or a 20 minute flight in a plane.*

Listening to music – *100 years ago you would only hear live music, and it wouldn't be rock and roll. Today you can hear any kind of music that is recorded on tape, CD, or record. You can also hear it live.*

Taking a bath – *There was no running hot or cold water 100 years ago. You would pour cold water into a tub of some kind. Water would be heating on a stove and you would pour enough boiling water into the tub to make a warm bath. Today preparing to take a bath only requires that you turn on the water faucet.*

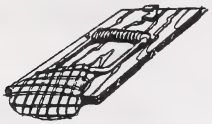
Sewing a shirt – *Sewing machines were around 100 years ago, but you powered them by a treadle (foot power). Today, sewing machines make an amazing assortment of stitches and they are electric. Your choice of materials is much greater now as well.*

(6 marks) + 2 Bonus

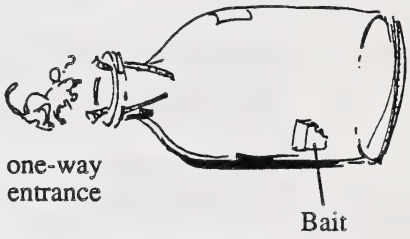
3. Pretend that you have been chosen to make a device that can catch a mouse alive. Draw a diagram of such a device and write labels to explain how it works. You get a two-mark bonus if it can catch more than one mouse at different times. This means that the second mouse will be caught while the first mouse is still in the device.

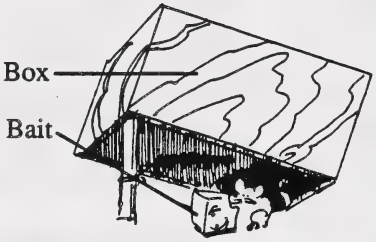
There are many possible ideas. Full marks will be given if it will work (even if it's not efficient). If the design is good but has a few obvious flaws, score 3-4. If the design is poor but has some working parts, score 1-2. Examples of designs follow.

Take a mousetrap and



Change the killing part to a net.





(4 marks)

4. New technologies can advance science. Suppose that an extremely strong metal is made. It's stronger than steel, but melts at 30°C. Suggest two things you could investigate with this metal, or choose two things to make out of it.

Again, there are many possible answers. Full marks are given if the investigation used both of the metal's properties (one mark for only one property). Examples are given.

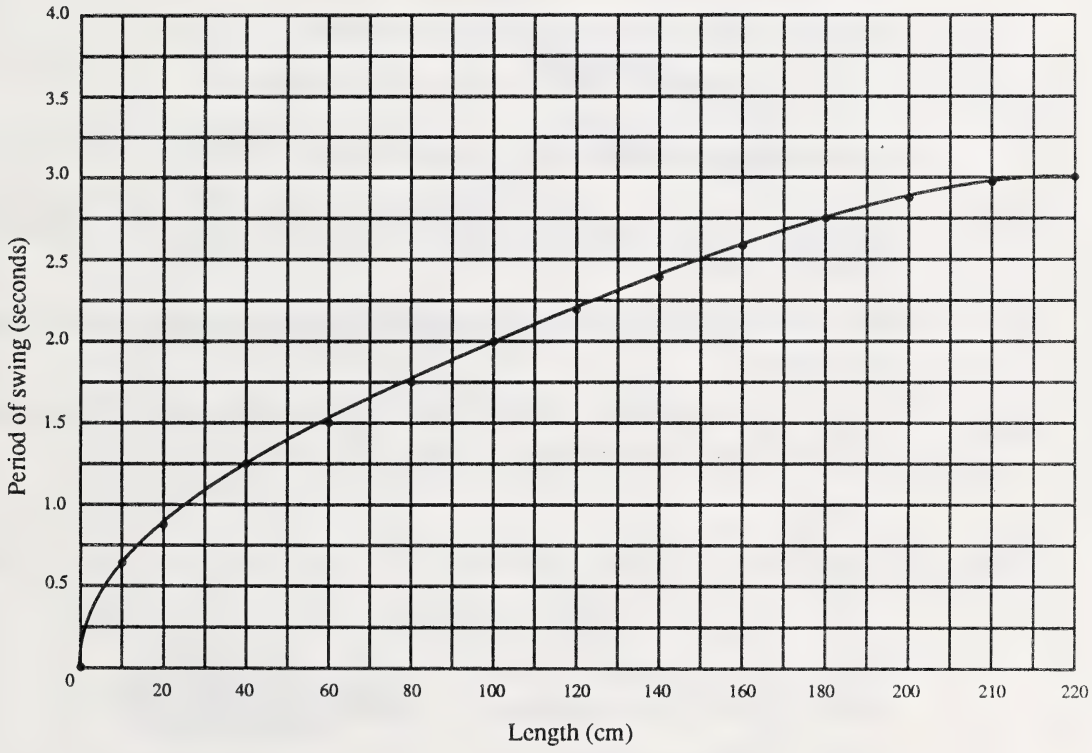
Build equipment to measure with in cold conditions (underwater).
Make a safety device that triggers at 30°C.

Section 2 Assignment (35 marks)

The Pendulum Investigation

(4 marks) **Observations**

Teacher Comment:
- Check for completeness. Any set of numbers is valid.
- Check the time of swing for a pendulum with this graph, or use the formula: Period = $2.00\sqrt{\text{length}}$ (in metres).



(3 marks) 1. Why did you time ten swings and divide? (Why not just time one swing?)

It's more accurate to time more swings and find the average length of time of one swing. It makes a timing error less important.

(2 marks) 2. Does the timing of the swing change from when you just released it to when it is barely moving?

No, the rate of swing is the same while the pendulum winds down.

(3 marks) 3. What is the relationship between the time of the pendulum's swing and how heavy the weight at its end is?

The weight doesn't change the pendulum's time of swing at all.

(3 marks) 4. What is the relationship between the length of a pendulum and its swing-time?

As the length gets shorter, the pendulum swings faster so its period of time for one swing is less.

(3 marks) 5. At this stage you have discovered a law about pendulums. How could you make a pendulum stay at a steady time of swing?

To make a pendulum steady you keep it at the same length.

(2 marks) 6. Name a technological device that uses this law you discovered.

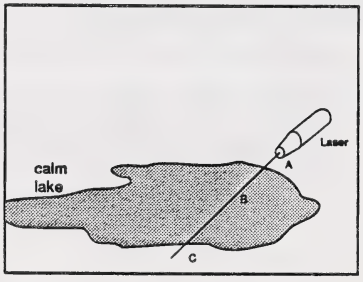
A clock uses this law. (Any other device that uses this ability to keep time may be acceptable.)

(5 marks) 7. While people are talking, air is forced through their vocal cords. Their voice box then vibrates to make sound. Who do you think has a bigger voice box, men or women? Use a property of sound to justify your answer.

Men. A man's voice is usually lower in pitch than a woman's voice. Larger objects produce lower pitches.

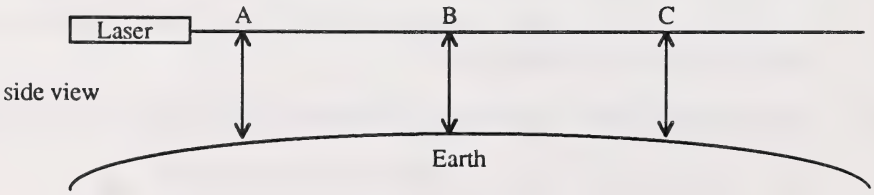
(6 marks) 8. Suppose you set a laser beam up to shine across a lake as shown. You would measure the height of the beam above the water at points A, B, and C. The heights are as follows:

A. 30.0 cm
B. 28.1 cm
C. 30.0 cm



What might you conclude from this data? (Hint: The beam goes in a straight line.)

Look at this exaggerated diagram.



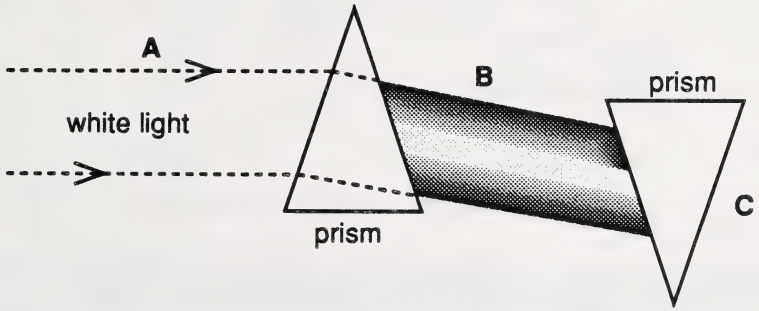
You can conclude that the Earth is curved. The lake water will lie "flat" on the Earth's surface.

(4 marks) 9. What is the difference between a scientific law and a theory?

A scientific law is a statement that describes the behaviour of some phenomenon. A theory is an attempt to explain the underlying principles behind the law.

Section 3 Assignment (40 marks)

(3 marks) 1. If white light is a mixture of all the colours, and a prism can separate the colours, then look at this diagram and indicate what will happen at the place marked C.

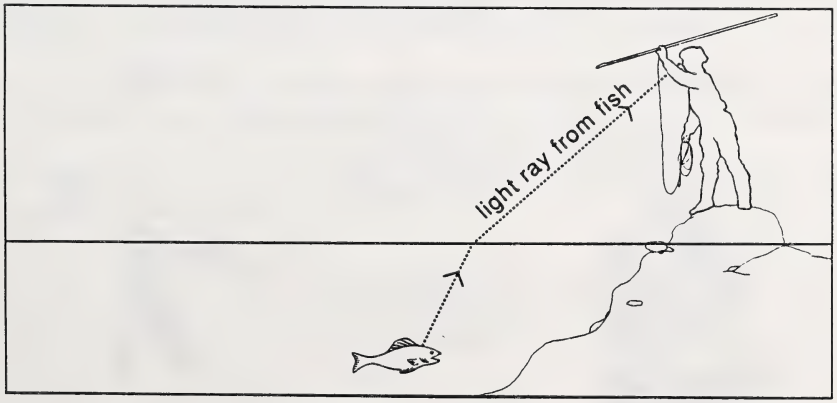


The colours mix black into white light. (The prisms are identical but placed in opposite ways.)
Teacher Comment: Isaac Newton did this.

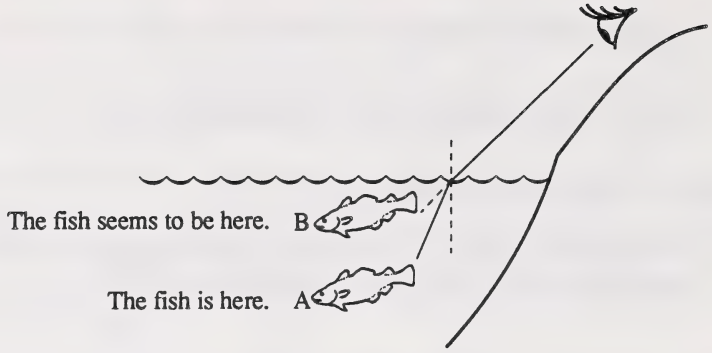
(5 marks) 2. As you move away from a light, it seems dimmer. Explain why.

The light spreads out so the photons are farther apart. There are fewer photons hitting your eye at a farther distance.

(5 marks) 3. Many fishing cultures spear fish from the shore of a pond or river. They know from practice that in order to spear a fish they must aim below where it appears. Look at this refraction diagram and explain why they aim below where the fish appears.



Our brains are "programmed" to believe that light travels in straight lines. The fish appears to be at point B in this diagram because that's where the light ray seems to come from.



(5 marks) 4. Do **either** Part A **or** Part B.

Part A

Give an example of a convex mirror in use. Why is it used there?

An example is a rear-view mirror. It gives a wide view (even though it's a smaller image). [Convenience store and gas station security mirrors also give a wide view.]

Part B

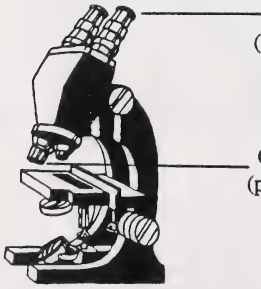
The bottom of a pop bottle is a crude convex lens. Why is it dangerous to leave a pop bottle in the woods when hiking (even if it is unbroken)?

The bottle can focus the sun's rays and start a fire just like a magnifying glass can.

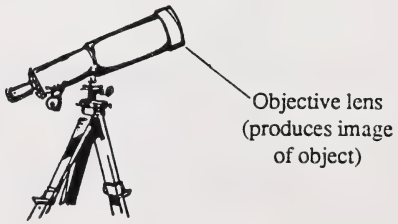
(6 marks) 5. Choose **one** of the following optical instruments and draw a diagram of it. Label the parts, and use these labels to describe how the instrument works.

- microscope
- telescope
- periscope
- camera

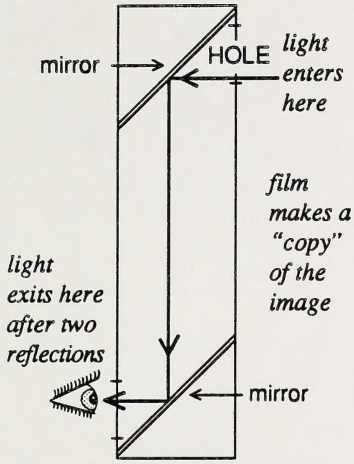
Microscope



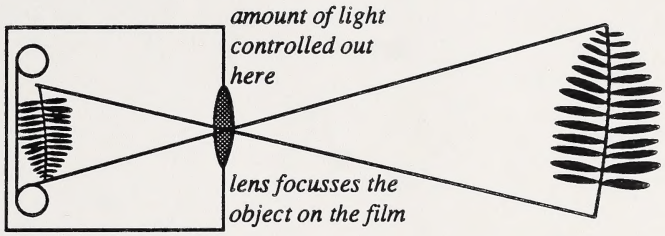
Telescope



Periscope



Camera



(5 marks) 6. Why does the thunder/lightning timing method work? Recall that for every 3 seconds of time between the lightning and thunder, the lightning bolt is 1 km away. Hint: How fast do light and sound travel?

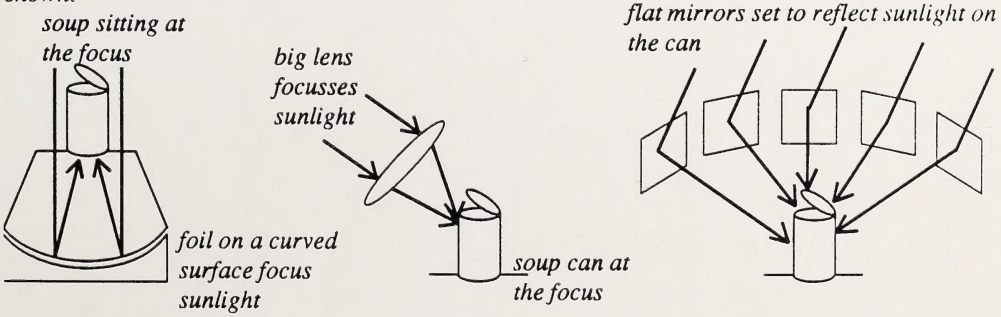
Light travels at 300 000 km/s so it gets to our eyes from the lightning instantly (or almost so). Sound however takes 3 seconds to travel 1 km, so however long it takes the thunder to reach us is a measure of the distance from the bolt of lightning.

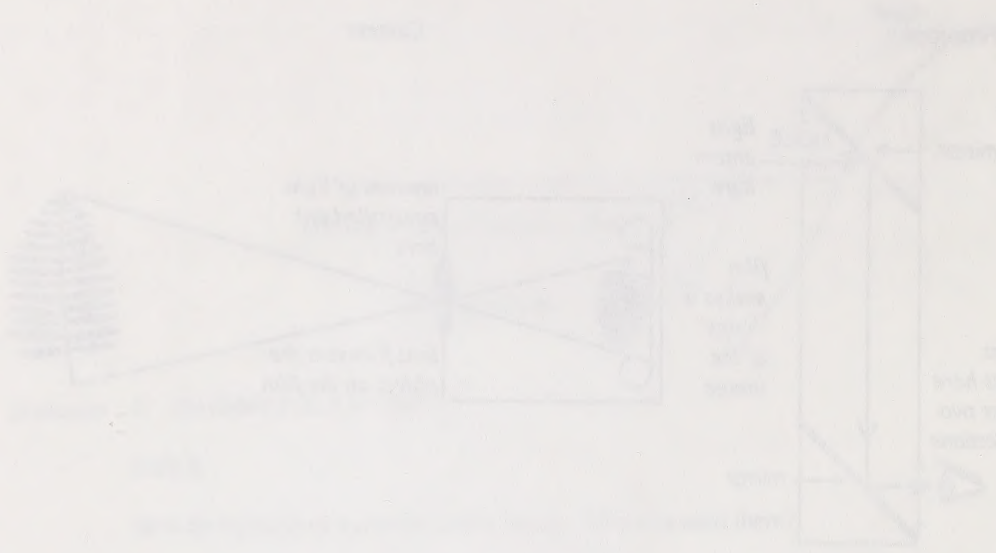
(4 marks) 7. What do all musical instruments have in common?

They all have a way to produce standing waves on or inside them.

(7 marks) + 2 Bonus 8. Pretend that you must design a solar cooker to make hot soup. Draw a diagram of your design. Label the parts, and use these labels to describe how the solar cooker works. Two bonus marks will be awarded if your cooker will work any time the sun is up.

Full marks are given if it will work. If the design is good except for a few flaws, 3 or 4 marks are given. If the design is poor but has some good qualities, 1 or 2 marks are given. Examples are shown.





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